Quantum information is a field of science responsible for groundbreaking advances in our understanding of the universe (e.g. tests of Bell inequalities proving that the world cannot be simply described as a sum of its parts) and amazing new technologies (e.g. quantum cryptography which provides unbreakable cyphers). Unfortunately, the progress on both levels is hindered by extremely high requirements on precision and efficiency of the necessary hardware. For experiments realized with photons (which are the most common in quantum information processing) the crucial requirement is the minimal efficiency of the detection, which is typically very high. The main aim of the project is to change this. This will have obvious benefits for science as it will enable more groups to perform experiments which so far were too difficult for them while the leading groups will be able to realize tasks which are now impossible. It will also facilitate the transition of quantum information processing into an applied science.

Fundamental experiments probing the nature of the universe as well as practical information processing protocols are based on a realization of some tests of nonclassicality. That is we prove that what has happened in our lab cannot be explained using classical physics. By this, depending on the nature of the particular experiment we confirm observation of a purely quantum phenomenon, for example, creation of a perfect cryptographic key. What we want to do is to develop tests which are simpler to perform thus making tasks like quantum cryptography much easier. To this end we will study larger quantum systems and experimental setups than the ones typically used now. Ultimately plan to prove the correctness of our approach by experimentally realizing the tests that we develop.